AF Note — 1

Agroforestry Notes

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Agroforestry in the United States

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Agroforestry: Past and Present

Agroforestry is an intensive land-management system that optimizes the benefits from the biological interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock (Garrett et al., 1994). Agroforestry is not a new concept, nor is it a new technology. For centuries, agroforestry has been practiced around the world and is most commonly associated with tropical and sub-tropical regions. Agroforestry has been practiced since the early 1900's in the United States.

In 1914, Russell Smith, an economic geographer at Columbia University, advocated the use of permanent tree-protected systems to maximize production on arable lands. But political and agricultural groups opposed his ideas of radical change in methods of food production. In the 1930's the Great Depression and "Dust Bowl" spurred political leaders to reconsider current policies and support research in this area. Investigative activities continued through the early 1950's until the post-war economic and industrial technology boom brought a sudden stop to the need for tree crop projects. It wasn't until the late 1960's and early 1970's that interest in trees and their potential role in food production and soil conservation was renewed; it is now commonly referred to as agroforestry. There were four reasons for this renewal: (1) environmental and ecological concerns; (2) decreasing availability and increasing cost of fossil fuel; (3) soil erosion rates and their direct effect on food production capacities; and (4) an increase in world population and subsequent demand for increased output. Since this time, the science of agroforestry has gained the interest of researchers and practitioners alike as an alternative land-use suitable for the temperate region of the United States. Agroforestry is an emerging concept and technology that bridges production agriculture and natural resource conservation with environmental enhancement and human needs.

Agroforestry technologies, when used appropriately, help attain sustainable agricultural land-use systems in many ways. Specifically, agroforestry technologies: 1) provide protection for valuable topsoil, livestock, crops, and both aquatic and terrestrial wildlife; 2) increase productivity of agricultural and horticultural crops; 3) reduce inputs of energy (physical, chemical, or biological) and chemicals; 4) increase water-use efficiency of plants and animals; 5) improve water quality; 6) diversify local economies; and 7) enhance biodiversity and landscape diversity, and ultimately, the quality of life for people.

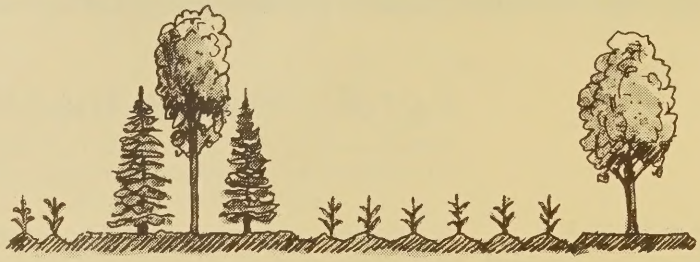
National Agroforestry Center

Agroforestry Practices

Agroforestry technologies are extremely flexible and can be tailored to work in almost any situation. The multitude of agroforestry practices and their design variations can be put into five categories: 1) alley cropping; 2) windbreaks; 3) riparian buffer strips; 4) silvopastoring; and 5) forest farming. Understanding the differences among these systems is the first step toward understanding and implementing agroforestry technologies.

Alley Cropping

National Arbor Day Foundation Illustration



Alley cropping systems can be designed in various ways. Shown here is a three-row strip with training trees and a single-row of crop trees.

This system has been widely researched and is most applicable to agricultural systems in sub-humid regions. Alley cropping systems are created by planting single or multiple tree rows at a wide spacing. This creates alleys where agricultural or horticultural crops are planted. High-value hardwoods such as oak, walnut, and ash are typically grown in alley cropping systems. Short rotation biomass species can also be incorporated into the design. The cost of waiting for financial return on the long-term investment in trees is offset by annual income provided from the row crops in the alleys and fruits (nuts) from the trees.

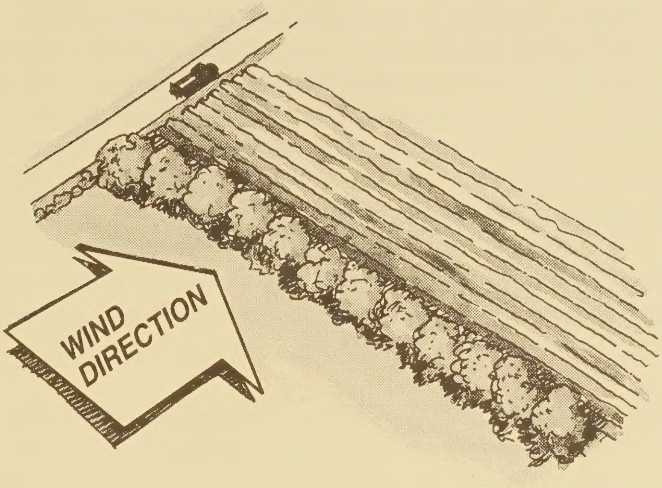
When designing an alley cropping system, it is important to carefully choose the tree species component. Choose species that are compatible with the site, satisfy landowner objectives, and have a viable product market. If multiple tree products are an objective, short rotation species (i.e., Christmas trees, biomass production) can be incorporated to encourage natural pruning and straight growth of the long rotation, high-value hardwood species. The spacing of the tree rows and their orientation must also be considered. Tree rows should be planted along the contour to maximize erosion control benefits, and be wide enough apart to permit machinery to maneuver between and around the tree rows. Depending on site quality and management expertise, more intensive multicrop systems (timber, nuts, crops, forage) can produce higher rates of return compared to just timber (Kurtz et al., 1984). The overall planting design must accommodate the planting, maintenance, and harvesting needs of the crop(s) planted.

Windbreaks

Windbreak agroforestry systems enhance crop production and protect livestock. Windbreak technologies are also applied to protect outdoor work areas from cold winds, protect roads from dangerous crosswinds and blowing snow, provide buffers in the rural/urban interface, and provide protection and buffers within communities. As a buffer zone, they reduce noise and dust and decrease energy consumption for heating and cooling. Frequently a landowner wants a windbreak to provide timber, create travel lanes, provide habitat for wildlife, or serve as a living fence. The intended function of a windbreak will dictate its placement and design parameters.

Windbreaks are designed so that tree and shrub rows are located as close to right angles to the prevailing wind direction as possible. In farming systems, windbreaks (field, livestock, farmstead) are usually two to five rows wide, but sometimes may be as many as eight if timber production is an objective. The number of rows depends primarily on the intended function of the planting, but it also depends on landscape characteristics. Windbreak densities of 40 to 60 percent provide the greatest downwind area of protection compared to a completely solid barrier. The downwind area effectively protected by

National Arbor Day Foundation Illustration



Field, farmstead, and livestock windbreaks can be designed for almost any situation. A field windbreak is shown here which will protect a windward distance of up to ten times the height of the trees and a leeward distance of 20 times the height.

a windbreak will extend out a distance of 10 to 20 times the height of the trees. If multiple field windbreaks are planted, the spacing between them should be less than or equal to this distance. Where blowing snow may be a problem, a living snowfence can be planted. It should be located 150 to 200 feet upwind from buildings, roads, and livestock confinement areas to avoid unwanted snowdrifts.

In the dry, windswept areas of the Great Plains and western states, establishing tree windbreaks requires a special effort. Fortunately, cost-effective material and equipment such as weed barrier fabric and drip irrigation systems are available that increase survival of new plantings.

Riparian Buffer Strips

Riparian buffers consist of perennial vegetation alongside streams, lakes, wetlands, ponds, and drainage ditches. They serve as protective barriers against the negative impacts of activities originating from adjacent land-use practices (agriculture, urban, industrial). Also, riparian buffer strips may be designed to process water carried away by field drain tile systems. They can stabilize streambanks and protect floodplains, reduce nonpoint source pollution, enhance aquatic and terrestrial habitat, improve landscape appearance, provide harvestable products, and function as a windbreak in some situations. Buffer strips are designed to meet landowner objectives and perform desired functions by adjusting plant material composition, width, and maintenance activities. For example, if sediment control of surface runoff is the priority then grasses alone are superior, but if agricultural chemical control, streambank stabilization, and wildlife habitat are the primary objectives, then a combination of grasses, trees, and shrubs function best. The design strategy is dictated by variables such as: land characteristics (slope, aspect, drainage pattern); objectives and desired functions (conservation, production, or both); current land use (grazing, row crop, grassed waterway, etc); and capacity for maintenance (low intensity vs. high intensity). When

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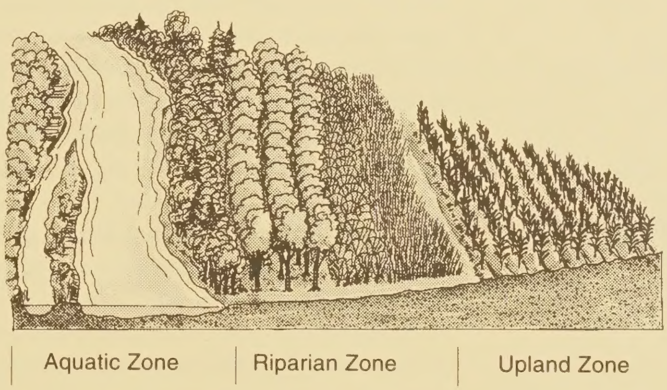

A riparian buffer strip can reduce floods and erosion, trap nutrients, and store water. Whether established or restored, they are a home for wildlife and a recreation area for people.

designing a new buffer, consider a multi-strata system consisting of bands of trees, shrubs, and grass paralling the drainage. Such a combination will yield a balanced combination of the many benefits buffers can provide. Excluding or properly managing grazing in riparian zones is vital to ensure the survival and function of the planting.

Silvopastoral Systems

Under this system, the overstory tree component creates favorable microclimate conditions for growing forage (pasture or hay), while growing a tree crop at the same time. This system is different from traditional forest or range management because it is intentionally created and intensively managed. Although currently practiced mostly in the southern and western United States, integrated tree/livestock systems are gaining interest everywhere because both economic production and environmental protection can be optimized.

The design and approach to creating a silvopastoral system from an existing woodland is similar to the shelterwood method, in that the density of the overstory is reduced to increase light and decrease competition, allowing the establishment of an understory crop. Alternatively, trees can be planted within existing pastures. Whichever method is used to establish the system, protecting the trees from livestock damage is vital, and proper management necessary. Select appropriate tree and forage species, tree spacing, and tree pattern to balance wood and forage production and meet the economic objectives of the landowner. Also, some systems are planted with tree species, such as honeylocust (*Gleditsia triacanthos*) that provide fruit and foliage suitable for supplemental livestock feed.

Forest Farming Systems

In contrast to other agroforestry options, these systems add agriculture to forestry (Hill, 1991). A forested area is modified for producing crops in addition to timber. The key factors are that the production system must be intentionally created and intensively managed. Examples include: maple syrup production, medicinal plants (ginseng is probably the best known and most valuable), craft materials (grasses, branches, tree burls, pine cones, seed pods, and evergreen cuttings), mushrooms, native fruits (persimmon, pawpaw), and nuts (black walnut, hazelnut). Removal of some trees may be necessary to create the appropriate shade conditions for the crop to be grown in the understory.

The Future

The opportunities for the application of agroforestry technologies are unlimited. Currently, millions of acres of economically marginal or environmentally sensitive cropland and pastureland in the United States could potentially be put into sustainable use using agroforestry technologies (Garrett et al, 1994). There are millions more acres of productive agricultural lands that could also benefit from adding agroforestry practices.

Agroforestry can contribute greatly to creating integrated agricultural and community systems that maintain productivity, protect natural resources, minimize environmental impacts, and provide for people's economic and social needs. Agroforestry is a system at a field scale, it is part of a system at farm and watershed scales. We now recognize that agroforestry is not an end in itself, rather agroforestry systems and technologies need to be blended and balanced with other technologies to attain sustainability goals. Strategically integrated into individual farm operations and watersheds, these technologies can create and enhance certain desirable functions and outcomes essential for sustainability: diversifying income, maintaining soil productivity, creating buffer zones to maintain water quality and reduce runoff, enhancing wildlife habitat, increasing resilience to stresses, and enhancing natural pest controls to reduce dependence on pesticides.

The attributes of agroforestry are well matched to our need to maintain productivity and profitibility, protect natural resources and the environment, and provide for people's

needs, now and in the future. Partnerships and teamwork between the natural resource and agricultural disciplines are essential to successfully address complex and critical issues associated with attaining sustainable development in agroecosystems. Agroforestry is very amenable to such an approach, and is applicable and effective whether it is implemented on an individual property or throughout an entire watershed

Additional Information

"Agroforestry and Sustainable Systems." Proceedings. Rietveld, W.J. (Technical Coordinator) 1995. Fort Collins, CO. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM - GTR-261

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Filing Category

Agroforestry Principles

Mission

The National Agroforestry Center (NAC) is a partnership of the USDA Forest Service and the USDA Natural Resources Conservation Service.

The Center's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable ecosystems.

To accomplish its mission, the Center interacts with a national network of cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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